Introduction

The sensory memory has been studied by presenting a fixed reference stimulus, a delay, and a range of test stimuli.

This method does not measure the contribution of the reference (Lages and Treisman, 1998). The Weber fraction characterizing this performance is the test stimulus Weber fraction.

We presented a range of reference stimuli as well as a range of test stimuli, and measured the relative contribution of the test and reference to the response, using the ratio of the test Weber fraction to the reference Weber fraction. When this ratio is unity, changes in the reference and test affect the response equally. When it is zero, performance does not depend on the reference stimulus.

Methods

Stimulus: two dark lines with variable horizontal separation on a bright background.
Reference: 7 separations, varying from 9.5 to 16.7 arc min, intermixed in each run.
Test: 6 separations surrounding reference chosen separately for each reference.
Probit analysis provided Point of Subjective Equality (**PSE**) and Standard Deviation (σ) of Gaussian cumulative fits to the frequency of seeing curves from each condition.
Interstimulus interval (**ISI**): 0.05, 0.200 or 2 sec.
Intertrial interval (**ITI**): 0.5 or 2.5 sec.
Observers: the first author and 2 naive observers.

Results

Test Weber Fraction

For both inter-trial intervals, the test Weber fraction increased slightly as the inter-stimulus interval increased from 0.05 to 0.2 sec. The increase was large (test performance was much worse) when the inter-stimulus interval increased to 2 sec.

The 2.5 sec inter-trial interval gave better test performance than the 0.5 sec interval at all inter-stimulus intervals.

Weber Fraction Ratio

A decrease in the ratio of the test Weber fraction to the reference Weber fraction indicates a decrease in sensitivity to changes in the reference relative to those in the test.

The slight performance decrease as the inter-stimulus interval increased from 0.05 to 0.2 sec was not accompanied by a decrease in the relative sensitivity to the reference.

Increasing the inter-stimulus interval to 2 sec did decrease the contribution of the reference, especially for the short ITI.

Individual patterns of test performance did not correlate completely with the Weber fraction ratio values.

Conclusions

Trial spacing improves performance.

Memory for the reference appears to decline slightly, but significantly, in 2 sec.

The ratio measure is a promising tool for examining sensory memory.

Ratio of Test to Reference Weber Fraction

The Weber fraction ratio for two reference stimuli depends only on their PSE's.
If R_1 and R_2 are the two references, with PSE's μ_1 and μ_2 and standard deviations σ_1 and σ_2.
Define

$$R = \frac{R_1 + R_2}{2} \quad \text{and} \quad \sigma = \frac{\sigma_1 + \sigma_2}{2}$$

The test Weber fraction at R is

$$W_T = \frac{\sigma}{R}$$

The discriminability of R_1 from R_2 is

$$d' = \frac{\mu_1 - \mu_2}{\sigma}$$

The reference threshold difference ΔR is

$$\Delta R = \frac{R_1 - R_2}{d'}$$

The Weber fraction for the reference stimuli at R is

$$W_R = \frac{\Delta R}{R} = \frac{R_1 - R_2}{d' R} = \frac{(R_1 - R_2)\sigma}{(\mu_1 - \mu_2) R}$$

The Weber fraction ratio is

$$\frac{W_T}{W_R} = \frac{\mu_1 - \mu_2}{R_1 - R_2}$$

This ratio is the fraction of Helson's Adaptation Level attributable to the reference value (Helson, 1964).